Modular Rocket Engine Control Software

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NASA is conducting studies with the goal of enhancing and furthering the technology base to support high-priority programs. To support propulsion system activities, basic research and technology must be accomplished in the engine-control and health-monitoring arena. To accommodate evolving technologies, this system must be modular to allow interface redesign as system requirements change. The Modular Rocket Engine Control Software, which is being developed by Loral Space Information Systems, is a research and technology effort whose primary purpose is to demonstrate software development and maintenance cost reduction by implementing a modular, flexible software architecture.

Approximately 40 people are presently working full time to support the development, verification, and validation of the space shuttle main engine controller software, including laboratory hardware and support software maintenance. A significant percentage of the time and manpower required for this effort centers on the verification and validation of main engine software. Software logic changes resulting from flight requirement changes and/or software logic corrections, plus the need for special test software, have occurred at a relatively high frequency, with each new version requiring verification and validation. Fifteen software versions have been flown on 45 space shuttle missions since return to flight in 1988—an average of a new software version every three flights.

The purpose of the Modular Rocket Engine Control Software contract is to determine and develop a mobile approach to software that allows the incorporation of new system requirements and technology developments in sensors, actuators, input/output, connectors, and health/safety-monitoring techniques with fewer software impacts and, thus, reduced costs. The modular software concept creates a “fire wall” between modules such that when the code is changed, only the affected module needs to be re-verified. Some of the logic errors discovered in the current main engine software might not have occurred with more compartmentalized software.

The Marshall Avionics System Test-Bed is being used to develop program software and for demonstrations of this software at key milestone events. An engine controller system has been installed in the Avionics Test-Bed laboratory, and verification of the software is in progress. A demonstration of a sensor input task was performed in June, with a proof-of-concept demonstration (including an engine health-management task) scheduled for September. Tasks planned for fiscal years 1996 and 1997 include actuator control, vehicle input processing, ground checkout, telemetry processing, and additional health management.

Modular main propulsion system software has been identified as a task item in the Reusable Launch Vehicle Long-Term/High-Payoff Technologies Program. The Modular Rocket Engine Control Software is anticipated to be a stepping stone in the evolving effort. Preliminary results from this contract indicate that it is the proper approach for future software. The reduction in time and manpower required for the verification and validation of software should result in significant cost savings.

Sponsor: Office of Space Access and Technology

Industry Involvement: Loral Space Information Systems